

REMARKS

Applicants respectfully request reconsideration of the present application in view of the foregoing amendments and in view of the reasons that follow. This amendment adds, changes and/or deletes claims in this application. A detailed listing of all claims that are, or were, in the application, irrespective of whether the claim(s) remain under examination in the application, is presented, with an appropriate defined status identifier. Claims 1-38 are now pending in this application.

I. The § 103(a) Rejections Should Be Withdrawn

Claims 1-38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pierrat in view of Irie further in view of Petersen and further in view of Okamoto. This rejection is respectfully traversed.

Applicants respectfully submit that the four reference rejection is based on hindsight reconstruction and that there is no motivation to combine the four references to arrive at the claimed invention. Even if there was motivation to combine the prior art references, the resulting combination would still not teach or suggest all claim limitations.

The independent claims of the present application recite exposing the same photoresist layer through two different masks, where dense features are exposed through one mask and the isolated features are exposed through another mask. This feature is not taught or suggested by any of the four references alone or in combination.

A. Pierrat

Pierrat does not teach grouping dense and isolated features on the different masks and exposing the dense and isolated features in the same photoresist using different masks. Pierrat teaches to expose the same photoresist layer twice through the same mask using a different axis of exposure to decrease the proximity effect (see Figures 5 and 6 and col. 4, lines 29-50 and col. 6, lines 20-64 of Pierrat). During each exposure, both the dense and isolated features are exposed in the photoresist layer.

Pierrat also teaches to expose the photoresist layer through two different reverse tone masks in Figures 7-9 and in col. 7, line 50 to col. 8, line 30. The photoresist layer is first exposed through the mask of Figure 2 of Pierrat followed by the exposure through a reverse tone mask to decrease the proximity effect. However, both the dense and isolated regions in the photoresist layer are exposed through each mask. Thus, in contrast to the statement on page 4, last paragraph, of the Office Action, Pierrat does not teach separation of dense and isolated features.

B. Irie

Irie does not teach or suggest exposing the same photoresist layer using two different masks. Irie teaches a method of making a photomask rather than a method of making a semiconductor device. For example, Irie teaches forming glass reticles (i.e., photomask) 34 that contains a metal master pattern 27 on one surface. Irie teaches to form dense patterns on the master pattern 27 on one reticle, Ra, and isolated patterns on another reticle, Rb. The exposure conditions for forming the different reticles, Ra and Rb may be different (see col. 22, lines 23-35). Thus, Irie teaches to form two different reticles, Ra and Rb, with one reticle containing dense features and the other device containing isolated features. A different photoresist layer is used to form the master pattern 27 on each reticle Ra and Rb. Irie does not teach to use both reticles Ra and Rb to sequentially expose the same photoresist layer over a semiconductor device or substrate. For example, the completed reticles Ra and Rb may be used to expose different photoresist layers formed over the same or different semiconductor device or substrate.

C. Petersen

Petersen also does not teach or suggest to use two different masks to expose the same photoresist layer. Petersen teaches that process exposure windows for different phase shift masks may be different. However, Petersen does not teach or suggest that these two masks are used to expose the same photoresist layer. For example, these masks may be used to expose different photoresist layers.

D. Okamoto

Okamoto was relied on in the Office Action for the teaching of a multilevel device. Thus, Okamoto was not relied on for a teaching to use two different masks to expose the same photoresist layer.

E. No motivation to combine

There is no motivation to combine the applied references to arrive at the claimed invention. Pierrat teaches that the use of reverse tone masks to expose the same photoresist layer reduces the proximity effect. Both the dense and isolated regions are exposed through the first and through the second masks. Irie and Petersen teach different masks, but do not teach that these masks may be used to expose the same photoresist layer. Thus, there is no motivation to substitute the reverse tone masks of Pierrat with the dense and isolated feature masks of Irie as modified by Petersen.

The office action on page 4, last paragraph implies that the motivation to combine is that the three references teach the separation of dense and isolated features on a photoresist. Applicants respectfully disagree. Pierrat does not teach to separate dense and isolated regions in the same photoresist since both dense and isolated regions are exposed through each mask. Likewise, Irie and Petersen do not teach to separate dense and isolated regions in the same photoresist since Irie and Petersen do not teach to expose the same photoresist through different masks.

Furthermore, Irie and Petersen do not necessarily teach to separate dense and isolated features on different masks for “multiple exposures” as noted on page 4 of the Office Action.

As discussed above, the separate masks may be used to single expose different photoresist layers to form dense features in one photoresist layer and isolated features in another photoresist layer.

The Office Action also notes on page 4 that Irie teaches that separation on two or more masks facilitates optimizing exposure conditions. However, Irie teaches that that separation of dense and isolated features on two or more masks facilitates optimizing

exposure conditions while forming the masks or reticles themselves. Irie does not teach that such separation is advantageous for exposing a photoresist layer over a semiconductor device or substrate, such as while forming a semiconductor device of Pierrat. Thus, this is an additional reason why there is no motivation to combine Pierrat and Irie.

F. The proposed combination would impermissibly modify Pierrat

Furthermore, the combination proposed in the Office Action would change the principle of operation of the method of Pierrat and make it unsuitable for its intended purpose. Such a combination is not permitted. MPEP 2143.01. The two mask method of Figures 7-9 of Pierrat operates on the principle of exposing both dense and isolated features in a photoresist layer through each mask, but with the tone of each mask being reversed. The purpose of this method is to reduce the proximity effect. If the reverse tone masks of Pierrat were replaced with the dense and isolated feature masks of Irie and Petersen, then the principle of operation of the method of Pierrat would be changed. Furthermore, this may make the method of Pierrat unsuitable for reducing the proximity effect.

G. The combination of references does not teach or suggest all claim limitations

Even if there was motivation to combine these four references, the combination would still not contain all limitations of the independent claims of the present application. None of the four references teaches exposing dense and isolation features in the same photoresist layer through different masks. To establish a prima facie case of obviousness, the Office Action must demonstrate that each claim limitation is taught in one or more references. In this case, the claim limitation reciting exposing dense and isolated regions in the same photoresist layer using different masks is not disclosed in any of the applied references. Therefore, a prima facie case of obviousness was not established.

II. Conclusion

Applicants believe that the present application is now in condition for allowance. Favorable reconsideration of the application as amended is respectfully requested. The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

Respectfully submitted,

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